A1250-1

SEPTEMBER 23, 1985

CHEMICAL & ENGINEERING

NEWS

Scientific news from the Chicago ACS meeting

Candidates in ACS fall election: Their views and backgrounds Page 52

Canada-U.S. Free Trade

Mixed feelings in Canada's chemical industry Page 7

0511179C095 9 W AR6338SL 1
CONGRESSIONAL INFO SERV-SRI
4520 EAST WEST HWY SUITE 800
SRI ACQUISITIONS
BETHESDA MD 20814

CHEMICAL & ENGINEERING
NEWS
Volume 63, Number 38
CENEAR 63 (38) 1–84
ISSN 0009-2347
SEPTEMBER 23, 1985

News of the Week

■ **Special Presidential envoy on acid rain says modest control program is warranted.** **Page 4**

■ **MRI will study relation of combustion conditions in municipal waste incinerators to emissions of chlorinated dioxins.** **Page 5**

■ **Number of AIDS cases will continue to rise rapidly in next few years, Centers for Disease Control experts predict.** **Page 5**

■ **Eli Lilly & Co. will purchase Hybritech, developer of monoclonal antibody techniques.** **Page 5**

■ **Rohm & Haas' earnings hurt by lower sales of herbicides and hybrid wheat seeds.** **Page 6**

■ **California board of education rejects science textbooks because publishers have watered down treatment of evolution.** **Page 6**

Letters 2

Concentrates
Business 14
Government 18
Science/Technology 24

The Departments
Meeting Briefs 46
Books 48
ACS News 50
Meetings 68
Newscripts 84

Business

Second-quarter earnings for biotechnology firms are mixed; growth for petrochemicals is forecast to head down. **Page 15**

Government

Spirited debate marked plenary session on nuclear weapon test ban at ACS meeting; queries answered on OSHA hazard communication rule; autopsy on "yellow rain" victim ambiguous. **Page 19**

Science

News from the ACS meeting: imaging method for mass transport; saving historical lab instruments; drinking hard water may reduce risk of heart disease; inhibiting kidney stone formation. **Page 29**

Education

Ways of teaching writing skills to chemistry students discussed in symposium at ACS meeting in Chicago. **Page 32**

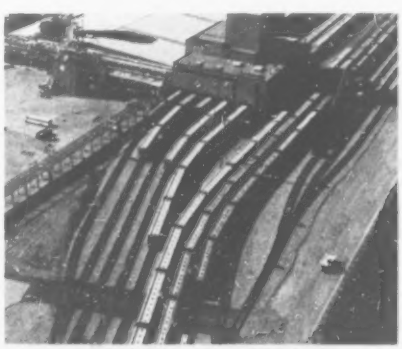
Technology

From the Chicago meeting: symposia on developing new materials for emerging technologies; salvaging waste plastics for reuse; bioadhesion mechanisms; cellulose structure; coal structure model; biomedical uses of polymers; organosilicon fungicides; and radioselective resins for waste disposal. **Page 34**

Bechtel subsidiary installs and operates custom-built, fluidized-bed incinerators at clients' waste sites. **Page 44**

ACS Election

Nominees for 1986 ACS president-elect, directors for Region I and Region V, director-at-large comment on ACS governance. **Page 52**



News Focus

Canada's petrochemical industry favors free trade with the U.S. but other segments of its chemical industry are hesitant. **Page 7**

Canada's Chemical Industry Split Over Canada-U.S. Free Trade Issue

Petrochemical sector favors free trade, whereas most small specialty chemical companies oppose it; producers of inorganic chemicals are in the middle

Earl V. Anderson, C&EN New York

When Canada's Prime Minister Brian Mulroney and President Ronald Reagan met in Quebec City on March 17 for what's been called the Shamrock Summit or Irish Love-In, bilateral free trade between the two countries was a top-priority item. It was clear then, and still is, that any free trade initiative would have to originate in Canada.

The top trade officials of each country were given six months to prepare a report on the possibilities. In Ottawa, Canadian Trade Minister James F. Kelleher is about set to deliver his report to Mulroney. It is almost certain to recommend an attempt to negotiate a bilateral free trade pact with the U.S.

Whatever policy evolves, it is sure to have a bearing on the chemical industries of both countries and the chemical trade between them. This article looks at the options available for bilateral free trade and their implications from a Canadian perspective. In a later article, C&EN will consider the U.S. point of view.

Anytime now, if it hasn't already happened since C&EN went to press, Canadian Trade Minister Kelleher will present a report to Prime Minister Mulroney. That report will outline possible ways to achieve freer trade (the buzzword in Ottawa is "enhanced" trade) with the U.S. It no doubt will recommend a preferred course of action.

In Canada, chemical industry leaders will be keeping a close eye on developments in Ottawa. So, too, will the trade experts in the U.S. chemical industry, because what's decided in Ottawa on free bilateral trade between Canada and the U.S. will heavily influence the fortunes of those two industries.

Whether Mulroney chooses to steer his country toward more open trade with the U.S. remains to be seen. Before he was swept into office and for most of his first year at the helm, he stood solidly behind the idea of free, freer, or "enhanced" trade with the U.S. as the best possible way to guarantee growth in Canada's all-important export markets. Canadian political analysts have sensed that he mellowed somewhat recently—a reaction, no doubt, to an outburst of opposition in Canada to free trade with the U.S. Historically, many Canadians have never relished the idea of jumping into economic bed with their big, overpowering neighbor.

But Ottawa watchers still think that Mulroney will

Prime Minister Mulroney greets President Reagan at Shamrock Summit

Inorganics and fertilizer are Canada's strong chemical trade suit

$ Million	Exports Total	Exports to U.S.	Exports % U.S.	Imports Total	Imports from U.S.	Imports % U.S.	Trade balance Total	Trade balance With U.S.
Mixed fertilizers	$ 18.6	$ 15.5	83.3%	$ 21.2	$ 20.6	97.1%	$ −2.6	$ −5.1
Plastics and synthetic resins	480.9	302.1	62.8	813.4	704.4	86.6	−332.5	−402.3
Pharmaceuticals and medicinals	113.8	33.6	29.5	411.8	191.8	46.6	−298.0	−158.2
Paint and varnish	14.1	11.9	84.3	114.1	106.4	93.2	−100.0	−94.5
Soap and cleaning compounds	21.0	14.2	67.6	29.8	23.9	80.2	−8.8	−9.7
Toilet preparations	23.4	19.6	83.7	88.6	54.1	61.1	−65.2	−34.5
Industrial chemicals	2267.4	1563.3	68.5	1657.6	1126.7	68.0	609.8	426.6
Pigments and dry colors	41.9	37.2	89.0	132.0	70.3	53.2	−90.1	−33.1
Inorganic chemicals	970.4	758.9	78.2	373.0	298.5	76.0	577.4	460.4
Fertilizer chemicals	265.5	209.6	78.9	135.9	107.7	79.3	129.6	101.9
Organic chemicals	989.6	547.6	55.3	996.7	650.2	65.2	−7.1	−102.6
Other chemicals	201.0	119.7	59.6	1029.5[a]	910.3[a]	88.4	−828.5	−790.6
Oils, fats, and waxes	15.6	9.2	58.9	96.2	85.1	88.5	−80.6	−75.9
Agricultural chemicals, formulated	17.4	11.9	68.4	195.0	160.7	82.4	−177.6	−148.8
Adhesives	5.4	3.7	68.5	30.9	27.5	89.0	−25.5	−23.8
Industrial chemical specialties	157.8	94.4	59.8	653.4	591.1	90.5	−495.6	−496.7
Explosives and ammunition	4.8	0.5	10.4	32.5	26.7	82.1	−27.7	−26.2
TOTAL CHEMICAL & ALLIED PRODUCTS	$3140.1	$2069.7	65.9%	$4166.0[a]	$3138.0[a]	75.3%	$−1025.9	$−1068.3

a Totals include imports of inks not included in table. About $22 million total, $19 million from U.S. Note: Numbers may not add exactly because of rounding and conversion from Canadian to U.S. dollars. Source: Department of Regional Industrial Expansion (Canada)

opt for some sort of broad, comprehensive trade agreement with the U.S. He could make such a decision right after receiving Kelleher's report. Or he could delay his choice until he has an opportunity to review his options once again with his provincial premiers, probably in November.

In any event, "Things are hotting up in Ottawa on trade," says one government official. "Every day the decision is delayed costs us money."

If there is going to be a free trade arrangement between the U.S. and Canada, matters indeed will have to "hot up" in Canada. Those who follow the Canada-U.S. trade issue have overworked the cliché, but the ball actually is in Canada's court.

While Trade Minister Kelleher readies his report for the Prime Minister, a counterpart report, now in draft form, is being written in Washington for President Reagan. At press time, the U.S. report was on the desk of Clayton Yeutter, the new U.S. Trade Representative (USTR). The report is "nothing fancy," says deputy assistant USTR William Merkin. "It is mainly their initiative," says Merkin. "Canada is the key player." Merkin confirms what everyone connected with U.S.-Canadian trade already takes for granted. If Canada proposes something, the U.S. will respond to it. If the Canadians don't propose anything, U.S. trade officials certainly won't either.

It's not difficult to appreciate Canada's concern about its markets in the U.S., especially with the heavy protectionist clouds that now hang over Capitol Hill. Canadian exports last year hit $83.8 billion ($1.00 = 1.31 Canadian dollars). Of that, $63.3 billion went to the U.S. That's a staggering 76% of the total. Canada's next largest export market took only 6% of the total—and that was the 10-country European Economic Community. Only 5% of Canada's exports went to third-place Japan.

Canada is the largest single-country export market for the U.S., too. Last year, 21%—$46.5 billion—of U.S. exports moved into Canada. That's a lot, but a far cry from Canada's 75% coming the other way.

In chemicals, the story is pretty much the same. Each country is the other's best single customer. But Canadian chemical companies are much more dependent on U.S. markets than U.S. companies are on Canadian outlets. That shouldn't be surprising. Canada's population, at 25 million, is roughly a tenth the size of the 237 million in the U.S.

Some other comparisons give a fuller picture. In 1984, Canada exported $3.1 billion in chemicals—66% of it to the U.S. Of the $22.3 billion in U.S. chemical exports last year, only 12% were shipped to Canada. Canada's chemical industry ran an overall trade deficit last year; it also was in the red in its trade with the U.S.

More than most countries, Canada is a trading nation. Close to 30% of its national income depends on international trade. Over the past few years, exports have accounted for 24 to 28% of chemical industry shipments. With the publicity that the trade issue has received in Canada lately, virtually every Canadian knows that his or her country is the only major industrialized nation without a captive market of 100 million or more people.

That's why the U.S. looms so large as Canada considers its trade policy for the future. Multilateralism notwithstanding, numbers such as those have convinced many Canadian business, academic, and political leaders that a bilateral trade pact with the U.S. is vital to Canada's future.

Not all of them to be sure. Many influential Canadians still think that Canada would be giving away the store if it entered a free trade pact with the U.S. Certainly, as the smaller partner in a Canadian-U.S. free trade arrangement, Canada would have the more difficult adjustment. In addition to the traditional

"branch plant" concerns—Canadian plants owned by U.S. companies shutting down and costing Canadians jobs—there are other deep-seated fears. One way or another, they revolve around the concern that Canadian political and cultural independence will be jeopardized under a free trade arrangement with the U.S.

Nevertheless, many authoritative studies have come out recently in favor of attempting to strike a bilateral trade deal with the U.S. The message in most of them is that the time to move is now. International competitive pressures are increasing. So is protectionism, especially in the U.S. And, given the enormous U.S. trade deficit, Canada's all-important markets in the U.S. may become blocked by additional legislation, even if that legislation isn't necessarily aimed at Canadian goods. Many leading Canadian trade experts see a very narrow "window of opportunity" to negotiate a bilateral free trade pact with the U.S.—a window that could close when off-year Congressional campaigning starts next year.

Typical of many of these studies is "Taking the Initiative—Canada's Trade Options in a Turbulent World." This study, prepared by the prestigious C. D. Howe Institute, Toronto, Ont., concludes that a bilateral trade agreement with the U.S. offers the best prospect of securing the export access that the Canadian economy needs.

In common with many Canadian leaders, Howe doesn't want Canada to abandon efforts to improve its trade position through multilateral trade negotiations under the General Agreement on Tariffs & Trade. It does believe, however, that the protectionist bias in EEC and tensions between the U.S. and Japan make significant progress "seem unlikely for several years, and perhaps longer."

It concludes, then, that bilateral free trade with the U.S. (along with multilateral negotiations) is the only choice that offers a realistic prospect for significantly improving Canadian export opportunities. What it suggests is a Canadian-American free trade area (CAFTA).

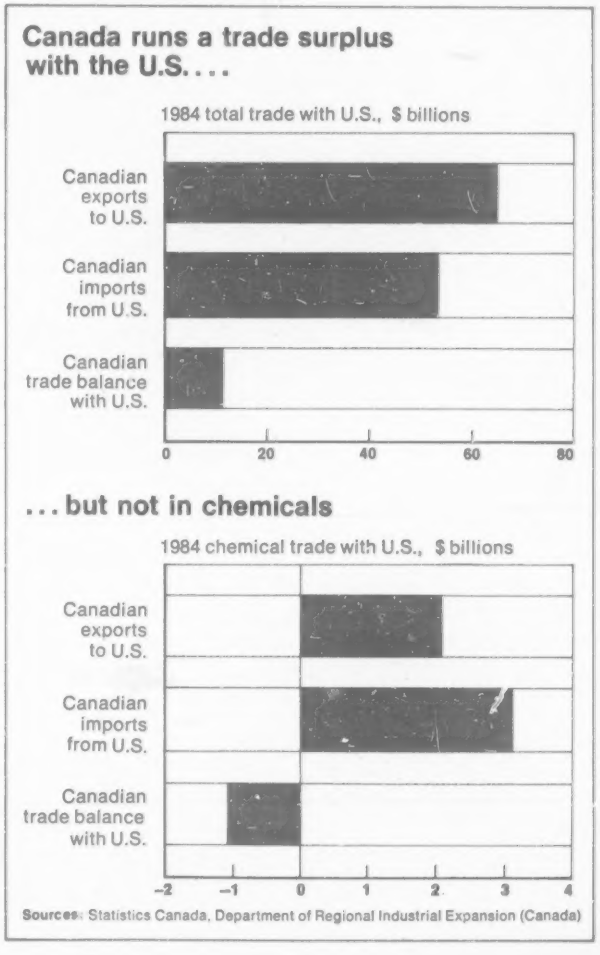
By process of elimination, says C. D. Howe, a CAFTA approach is the only effective way of initiating bilateral trade negotiations with the U.S. It rejects outright the sectoral approach, under which specific industries or "sectors" are earmarked for liberalized trade. A stab at sectoral agreements between the U.S. and Canada was tried as recently as 1983. Petrochemicals were one of the sectors under serious consideration.

C. D. Howe says that it's too hard to identify individual sectors in which both countries would have mutual interests (and find mutual benefits) in freer trade. Much negotiating effort, says the institute, could be spent obtaining very disappointing results. That's no doubt why the attempt at sectoral free trade has fallen by the wayside. It's also why almost everyone agrees that no attempt will be made to revive it.

With minor variations on the theme, many other major organizations agree with C. D. Howe that a comprehensive trade agreement with the U.S. is the way to go. Among them are the Canadian Export Association, the Canadian Manufacturing Association, and the Canadian Chamber of Commerce.

Recently, a Canadian commission recommended that the Canadian government move quickly toward a free trade arrangement with the U.S. The commission, officially the Royal Commission on the Economic Union & Development Prospects for Canada, was appointed three years ago to study the Canadian economy and its prospects. Known more popularly as the Macdonald Commission after its chairman, former Finance Minister Donald Macdonald, it suggested that all tariffs between the two countries be phased out over 10 years and that a U.S.-Canadian intergovernmental agency be created to supervise trade rules. Even a special joint committee of Canada's Senate and House of Commons, with representatives of all the country's major political parties, has urged a stab at more liberal trade with the U.S. Of the 10 Canadian provinces, nine are in favor of freer trade with the U.S. Ontario, with its huge manufacturing base built up largely behind high tariff walls, is the lone provincial holdout. To nobody's surprise, most of Canadian labor is also against freer trade.

Beefing up Canadian exports was a key Mulroney campaign pledge. And he cannot realistically ignore the groundswell of support that has emerged throughout Canada for at least an attempt to negotiate a free



Kissick: there will be some pluses and some minuses, but on balance we should benefit

trade agreement with the U.S. That's why Ottawa watchers are betting that Mulroney will opt for as broad and as comprehensive a trade arrangement as possible with the U.S.

How does Canada's chemical industry feel about that? It all depends, as always, on whom you talk to.

Some firms are passionately in favor of free trade with the U.S.; some are lukewarm; others are strongly opposed. The pro free-traders tend to be bunched in the petrochemical sector of the industry. Most small specialty chemical firms want no part of it. In the middle are the producers of inorganics, on which most tariffs already have been eliminated or soon will be.

Donald E. Wood, for instance, says that Polysar is in favor of free trade with the U.S. Wood, in charge of business logistics and development for Polysar's basic petrochemicals group, notes that the company would like to see free trade in styrene, polystyrene, and polyethylene. Polysar doesn't make polyethylene, but supplies ethylene to those that do, now that it has acquired all of Petrosar.

Polysar is based in Sarnia, Ont. Further west, in Alberta, is where most of Canada's petrochemical capacity is built. It's also where most of the chemical industry's free-trade support is concentrated. A. E. (Sam) Egglestone, senior vice president of Alberta Gas Chemicals Ltd. (AGCL), says that tariffs on methanol should be dropped by both countries. AGCL has 240 million gal per year of methanol capacity at Medicine Hat, Alta.

Novacor Chemicals Ltd. also favors free trade with the U.S. The company is a major petrochemical producer in Canada. It has 2.7 million lb per year of ethylene capacity, about 60% of Canada's total. It has about 25% (600 million lb annually) of Canada's polyethylene capacity and about the same percentage of polyvinyl chloride capacity (200 million lb).

Naturally, Novacor also would have liked to see sectoral free trade in petrochemicals. It still does. But Novacor's position on free trade with the U.S. goes beyond that. Says John P. Sutherland, the company's vice chairman, "We most urgently seek freer trade ... in a comprehensive agreement with the U.S."

Along with the rest of the petrochemical sector, Union Carbide Canada Ltd. feels strongly about a petrochemical accommodation with the U.S. But as company chairman and chief executive officer W. Norman Kissick points out, Carbide Canada is in many businesses besides petrochemicals; therefore the impact on the company of a comprehensive free trade arrangement is not that clear-cut. "There will be some pluses and some minuses," says Kissick, "but on balance, we should benefit."

Kissick cautions, however, that about 75% of the company's business is selling to other Canadian companies. "If they're in jeopardy [as a result of free trade], we won't survive," he says. "We listen to them."

Unarguably the most diversified of the large Canadian chemical companies is C-I-L Inc. Its vice chairman, David I. W. Braide, says, "C-I-L has nailed its flag firmly to the mast of as broad an agreement as possible." As a diversified company, Braide warns, C-I-L could be hurt by removing some Canadian tariffs. But in the long run, he adds, C-I-L will benefit more through free trade than with the status quo. "It will be an invigorating process for the entire Canadian economy," says Braide.

These are all large companies. Among smaller chemical companies, affection for free trade with the U.S. doesn't run that high. An executive of one small Canadian chemical specialty company points out that companies like his were developed behind a tariff wall. "There will be no more Canadian plants built in secondary or tertiary industries if we go free trade," he says.

Indeed, the Canadian Manufacturers of Chemical Specialties Association hasn't even taken a position on the free trade issue. Its president, Peter Nott, doubts it ever will. Its 100-odd company members are just too diverse to come up with a policy that will satisfy them all, he says.

Opinions such as these—pro, con, and all shades in between—have been pouring into the Department of External Affairs ever since Trade Minister Kelleher issued a discussion paper, "How To Secure and Enhance Canadian Access to Export Markets" earlier this year. The paper asked for information, views, and perceptions on the trade issue. The department got them in droves. After laying out some background data, the discussion paper really boils down to four questions on Canada-U.S. trade relations:

Should we continue as we have in the past?

Could we negotiate sectoral or functional arrangements?

Do we need a comprehensive arrangement?

Is a framework agreement necessary?

The discussion paper virtually answers its own questions on the first two. On the status quo, it notes that the "present situation" may not adequately serve Ca-

nadian economic interests. And it wonders if enough political and private sector support can be mustered for a sectoral or functional approach. Probably not. It's been tried and has gotten nowhere, though it still remains a petrochemical industry favorite in Canada.

The big disadvantage of the sectoral approach is that it is difficult to get a balance of benefits on both sides of the border in a narrow industrial sector. That is why the U.S. chemical industry wanted to broaden the petrochemical approach taken by the Canadians as recently as last year. Another argument against sector agreements is that they may run counter to GATT rules. There is, of course, the long-standing Canada-U.S. auto pact, which provides duty-free trade for automobiles and most original parts, subject to certain Canadian production guarantees. But trade officials doubt that a new sectoral agreement between the U.S. and Canada would get GATT's blessing again.

That leaves a comprehensive agreement and a "framework" agreement. Support in Canada for a comprehensive agreement has been growing. Such an approach would remove tariff and nontariff barriers on substantially all bilateral trade. It would conform with GATT requirements. And it would leave intact the trade barriers that each country maintains against third countries.

After penetrating the bureaucratic language barrier, a "framework" agreement would be nothing more than a jawboning exercise. Under a "trade enhancement agreement," another name for the same thing, the two countries would form a joint consultative committee to discuss issues and develop work programs. Specific mechanisms could be set up to discuss and possibly resolve trade conflicts.

The major chemical industry response to the discussion paper has come through the Canadian Chemical Producers Association (CCPA), Canada's counterpart to the Chemical Manufacturers Association in the U.S. CCPA represents 66 companies that produce about 75% of Canada's industrial chemical and synthetic resin output. CCPA divides itself into three product sectors—petrochemicals, inorganics, and organic/specialty chemicals.

Therein lies its problem. Member companies have different attitudes on free trade with the U.S., depending upon their product line. Member companies come in all sizes; some are national, others multinational. What makes sense for one doesn't necessarily make sense for the other. Because its membership is anything but homogeneous, it's very difficult for CCPA to take a solid, one-posture position.

So it doesn't. Understandably, it tries to pick the best of all the worlds that Kelleher's discussion paper has to offer. "There are no black and white choices," CCPA has told the Department of External Affairs.

CCPA rejects the status quo option outright. As protectionist pressures increase, especially in the U.S., CCPA believes that continuing to do what Canada has done in the past will be like jumping continually from one brushfire to another.

CCPA likes sectoral free trade for petrochemicals, even though it knows that the narrow sectoral approach has been all but abandoned. "We think that a purely sectoral approach would not get off the ground," says Jean Belanger, CCPA's president. But CCPA's petrochemical members want it. CCPA wants it for them. Yet, other member companies are less than enthusiastic about sectoral or any other kind of free trade.

CCPA deftly runs the gauntlet by advocating what Belanger calls a "pragmatic" approach. It supports speedup efforts to establish a framework, consultative agreement, such as a trade enhancement agreement. That, after all, involves only talk, and little harm can come from it.

But CCPA hedges on a broad, comprehensive agreement. It wants an effort to be made, but it should be, says CCPA, "a continuing effort to assess and build consensus." In other words, more study, more talk.

All of this study and talk, of course, will take time. But CCPA points out that some opportunities for freer trade shouldn't wait until all of the study and talk end. One of those opportunities, of course, is petro-

Canada's petrochemical wish list

When sectoral free trade between the U.S. and Canada was still a possibility, the Canadian chemical industry strongly pushed petrochemicals as one of the sectors. Here are its candidates for petrochemical free trade:

Product	Tariff rates[a] (% and/or cents per lb) Canada	U.S.
Styrene	7.5%	7.4%
Cyclohexane	10.0%[b]	0.9¢ + 12.5%
Ethylbenzene	9.2%[b]	0.5¢ + 17.3%
Carbon tetrachloride	9.2%	2.3%
Ethylene dichloride	10.0%	0.6¢ + 3%
Vinyl chloride	12.5%[b]	12.0%
Propanols[c]	12.5%	14.0%
Methanol	10.0%	18.0%[d]
Ethylene oxide	9.2%	9.0%
Ethylene glycol	10.0%	12.0%
Phenol	9.2%	1.3¢ + 12.5%
Acetic anhydride	12.5%	3.5%
Acetic acid	12.5%	1.8%
Adipic acid	12.5%	0.1¢ + 19.8%
Hexamethylenediamine	12.5%[b]	20.0%[e]
Acrylonitrile	6.3%[b]	11.8%
Alkylbenzene	Free	0.5¢ + 17.3%
Polyethylene	10.1–11.1%	12.5%
Polyvinyl chloride	9.5%	10.1%
Polystyrene	9.5%	0.4¢ + 9.2%
Vinyl acetate	12.5%	3.8%
Styrene-butadiene latex[f]	Free	Free
Sytrene-butadiene latex[g]	9.5%	0.4¢ + 9.2%
Acetaldehyde	12.5%[b]	8.0%
Adiponitrile	10.0%	13.5%
Nylon 6	7.5–10.0%	6.3%
Nylon 66	8.5–10.0%	6.3%

a Tariff rates effective January 1987 when Tokyo round tariff cuts are fully phased in. b Free under a temporary rate reduction for plastics use. c 1-propanol and 2-propanol. d Free for fuel use. e Benzenoid based. f Rubber. g Nonrubber. Source: Canadian Chemical Producers Association

chemicals. What CCPA proposes, then, is integrating sectoral free trade negotiations for petrochemicals into what it calls a "broad negotiating framework." But that broad negotiating framework, as CCPA sees it, is little more than further study and more talk. The message that CCPA hammers home to the Department of External Affairs is that "the Canadian petrochemical industry needs action now." Whatever else is done, CCPA wants to see a joint working party established to negotiate a free trade pact in petrochemicals.

Petrochemical free trade has been a goal of Canada's chemical industry for some time. After the Tokyo round of trade negotiations ended in 1979 with U.S. tariff concessions somewhat less than what Canada sought, Peter Lougheed, at the time Alberta's Premier, suggested a free-trade approach on about 10 major petrochemicals. It was the time of energy crisis. Canada's pitch was: If you want our energy, you must take some of our petrochemicals with it.

Last year, a petrochemical task force issued a major report on problems and prospects of the industry. The major issue was Canadian energy and feedstock policy. But the number two problem was trade, said the report.

Even before the task force issued its report, CCPA was busy on sectoral free trade for petrochemicals. In 1983, it broached the subject in a couple of meetings with its counterpart CMA in the U.S. It compiled a list of petrochemicals that it considered possible candidates for free trade.

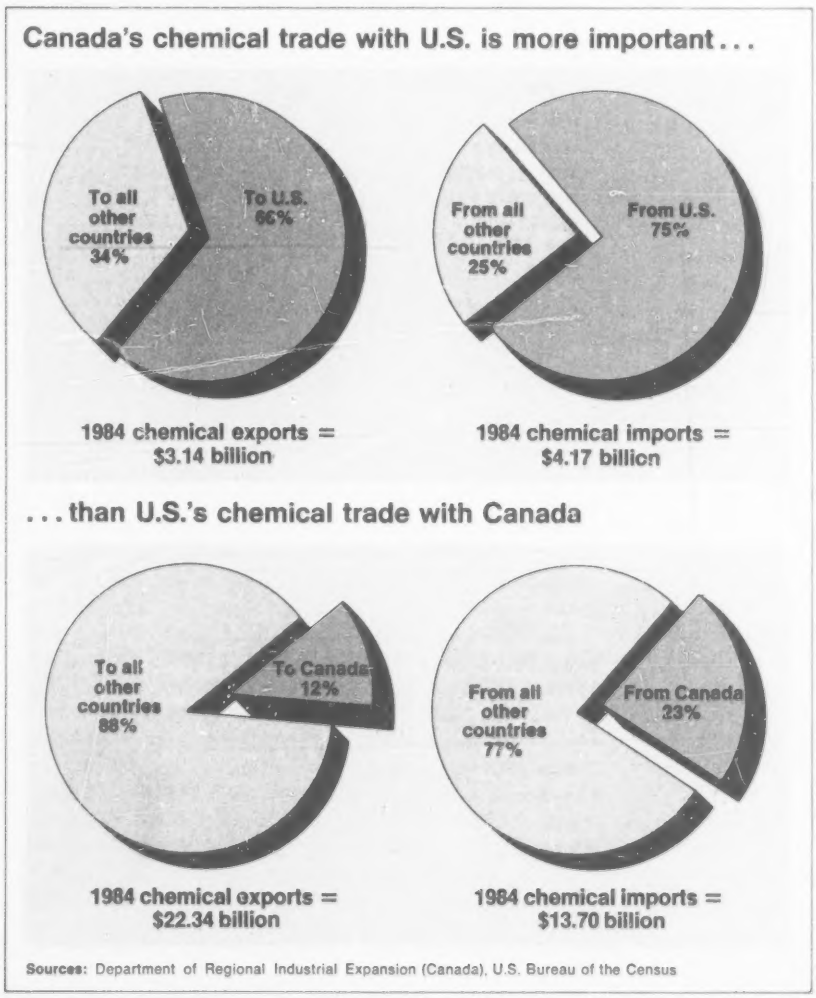
On the U.S. side, CMA made it clear that a "government umbrella" would be needed if petrochemical free trade talks were to continue. Former Prime Minister Trudeau first opened that umbrella when he proposed that the two countries consider four primary industries as candidates for sectoral free trade. Petrochemicals were one of the secondary candidates. When the Conservatives ousted the Liberals in Canada last year, the umbrella closed, if only temporarily. And by the time Reagan and Mulroney met in Quebec City, sectoral free trade had been discarded as a negotiating option.

Certainly, however, Canada's preoccupation with free trade for petrochemicals is understandable. During the 1950s and 1960s, Canada's petrochemical industry had small plants geared to the domestic market. Meanwhile, economical, world-scale plants were being built elsewhere. Even with inexpensive and abundant feedstock, Canadian producers couldn't compete. Between 1965 and 1974, petrochemical production in Canada rose only half as fast as domestic consumption. Trade moved from balance to a $460 million deficit.

In the early 1970s, Canada's petrochemical producers went on a construction binge, building world-scale plants of their own, particularly in gas-rich Alberta. These plants still had only a small domestic market, so exports became critical. Producers were able to increase petrochemical exports sixfold between 1974 and 1983. Canada has had a petrochemical trade surplus every year since 1979.

About 45% of Canada's basic petrochemical production is exported. More than half of those exports, 57%, go to the U.S. No wonder the petrochemical sector of Canada's chemical industry has its fingers crossed for free trade with the U.S. Meanwhile, its eyes are on Washington, D.C., where it fears that a protectionist rash will rub off on Canadian petrochemicals.

CCPA's inorganic and organic/specialty chemicals members are in a different boat, however. CCPA is working now with its inorgan-


Canada's chemical trade with U.S. is more important . . .
To all other countries 34%
To U.S. 66%
1984 chemical exports = $3.14 billion
From all other countries 25%
From U.S. 75%
1984 chemical imports = $4.17 billion
. . . than U.S.'s chemical trade with Canada
To all other countries 88%
To Canada 12%
1984 chemical exports = $22.34 billion
From all other countries 77%
From Canada 23%
1984 chemical imports = $13.70 billion
Sources: Department of Regional Industrial Expansion (Canada), U.S. Bureau of the Census

ics members to clear up some uncertainties about their ability to compete internationally and to define more clearly their most worrisome nontariff barriers.

In the organics/specialties segment, the situation is more clear-cut. Many companies just don't want free trade with the U.S. or anybody else. "The viability of firms [in this sector] would be seriously impaired, if not destroyed," says CCPA, if a free trade agreement forced Canada to remove tariffs on their products.

In the inorganic chemicals industry, about 75% of total shipments are commodity products, made in large, efficient, world-scale plants using the best technology available. These plants are big enough to serve both domestic and foreign markets. For some commodity products, free trade with the U.S. already exists, or is very close. Tariffs on sulfuric acid, chlorine, and caustic soda will disappear in 1987.

The remaining 25% of Canada's inorganics shipments are many small-volume products produced in small plants built to serve regional, even local isolated markets. They could be vulnerable if they lost tariff protection. Historically, Canadian inorganics producers have had a serious cost disadvantage competing against U.S. companies.

Thus the prospect of free trade with the U.S. gets a mixed reception among Canada's inorganics producers. In some commodity products, tariffs have all been eliminated already. But CCPA feels that others would be hard hit if Canadian tariffs were erased. Meanwhile, as tariffs disappeared, nontariff barriers would become more important. CCPA wants more time to take a closer look at them.

Canadian companies in the organics/specialties sector say they would feel naked stripped of their tariff protection. They have no raw material price advantage over U.S. producers, says CCPA. Many products in the sector serve small, specialized markets. They are impractical to produce in Canada. Already, about two thirds of domestic demand is satisfied by imports. Canadian specialties production doesn't usually start until the domestic market is large enough to support it. Even then the plants usually are small, flexible, multipurpose units with batch, rather than continuous, operation.

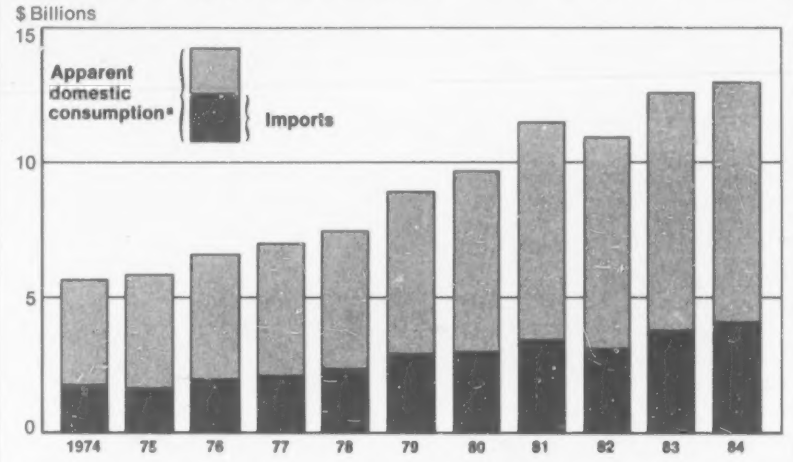
Their small size puts them at a disadvantage, says CCPA. Canadian specialties producers usually get their technology through licensing. CCPA fears that these arrangements could dry up under free trade, and the companies' small size makes it uneconomical for them to develop their own technology.

For CCPA, then, developing a response to the trade minister's questions on free trade has been a case of different strokes for different folks. The Society of the Plastics Industry of Canada (SPIC) has no such problems.

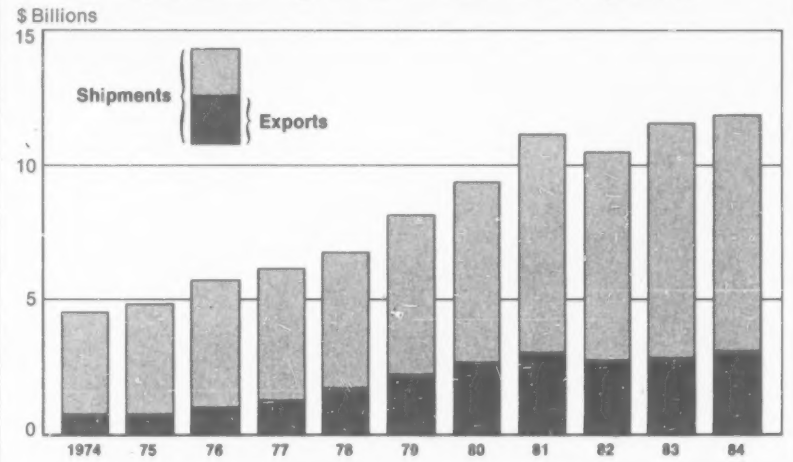
Canadian plastics processors already have almost duty-free access to the U.S. market, and its own domestic market remains fairly well protected. As far as bilateral free trade is concerned, then, SPIC would just as soon leave things the way they are.

No doubt, each segment of the Canadian chemical industry will refine its position as the push toward bilateral free trade progresses. But the first step must yet be taken by the prime minister in Ottawa. The ball still is in his court. Then it will be a question of whether the U.S. can, or wants to, play ball. □

Imports are big part of Canadian chemical market . . .



. . . and exports are big factor in chemical shipments



a Apparent domestic consumption is defined as domestic shipments plus imports minus exports.
Source: Department of Regional Industrial Expansion (Canada)

Biotechnology Firms Post Varied Results in Second Quarter

Producers of diagnostics based on monoclonal antibody technology register strong gains; earnings deficit increases at Genex

David Webber, C&EN New York

The variety of financial results reported by biotechnology-based companies for the second quarter of 1985 continues to reflect the range of progress the firms have achieved in following their business plans. A few companies are turning in respectable profits on product sales, whereas others report minor to substantial net income still derived almost exclusively from contract research fees. Most firms, however, continue to lose substantial amounts of money each quarter as they plow revenues back into their efforts to find a safe spot in the ever more precarious biotechnology field.

Among the handful of companies with significant revenues from their own biotechnology-based products, Hybritech—which agreed last week to be acquired by Eli Lilly for more than $300 million—continues to set a strong financial pace. The San Diego company, which manufactures and markets diagnostic kits using monoclonal antibody technology, more than doubled its revenues in second-quarter 1985 to $14.7 million, compared with last year's second quarter. On the basis of product sales alone, the improvement was even better; sales jumped to $8.1 million, up 134% over the same period a year earlier and up 25% over first-quarter 1985.

Almost all the company's remaining revenue reported in the second quarter came from contract work, revenues for which rose 77% in the quarter. Most of those fees, Hybritech notes, paid for product development programs principally aimed at moving the company into both new diagnostic markets and therapeutics. The only revenue source to decline was interest income, which fell as cash was invested in working capital and facilities. At the end of June the company had $12.3 million in cash and cash equivalents. As a result, Hybritech's net income soared more than 1000% over the same period a year earlier to $538,000 (exclusive of an extraordinary tax credit).

Hybritech's rapid move to profitable commercialization of its products has been largely the result of its concentration on monoclonal antibody-based diagnostics. For the most part, markets already exist for such products, regulatory approval hurdles are much lower than for

Most biotechnology firms still operate in the red

	SECOND-QUARTER 1985[a]						FIRST-HALF 1985[a]					
	Revenues[b]	Earnings[c]	Change from 1984		Profit margin[d]		Revenues[b]	Earnings[c]	Change from 1984		Profit margin[d]	
	($ millions)		Revenues	Earnings	1985	1984	($ millions)		Revenues	Earnings	1985	1984
Amgen	$ 3.337	$−2.035	77%	def	def	def	$ 6.687	$−3.753	83%	def	def	def
Bio-Response	1.118	−0.613	336	def	def	def	1.677	−1.620	276	def	def	def
BioTechnica International	1.270	−0.676	229	def	def	def	2.495	−1.434	216	def	def	def
Biogen	6.686	−2.784	−14	def	def	def	11.550	−7.760	−16	def	def	def
California Biotechnology	2.362	0.048	15	23%	2.0%	1.9%	4.349	−0.061	7	def	def	3.1%
Centocor	5.430	0.413	97	601	7.7	2.2	9.820	0.667	87	966%	6.8%	1.2
Cetus	10.770	0.534	−21	45	5.0	2.7	23.398	0.745	−9	57	3.2	1.9
Collaborative Research	2.127	−1.193	−43	def	def	def	4.342	−2.253	−25	def	def	def
Damon Biotech	0.924	−2.614	−40	def	def	def	1.599	−5.609	−45	def	def	def
DNA Plant Technology	1.068	−0.121	30	def	def	def	2.014	−0.250	39	def	def	def
Genentech	21.412	1.101	24	76	5.1	3.6	41.576	1.816	28	80	4.4	3.1
Genex	4.800	−2.300	−41	def	def	def	9.400	−4.700	−33	def	def	def
Hybritech	14.676	0.538	104	1070	3.7	0.6	26.260	0.673	110	683	2.6	0.7
Molecular Genetics	1.902	−0.735	−14	def	def	0.9	4.242	−1.214	−12	def	def	def
Monoclonal Antibodies	1.792	−0.601	72	def	def	def	3.317	−0.994	96	def	def	def

a For three-month or six-month period ending closest to June 30. b Includes sales, contract research, royalty, and interest revenues. c Excludes extraordinary credits. d After-tax income as a percentage of revenues. def = deficit

human therapeutics, and the technology is far easier than that for, say, recombinant DNA. As Hybritech and other companies that are currently selling diagnostic kits attempt to make the leap into monoclonal-based therapeutics, which are potentially far more lucrative, they will have to overcome much greater obstacles to commercialization of their properties.

Reporting good sales increases from similar products, though on a smaller scale, is Monoclonal Antibodies Inc. The Mountain View, Calif., firm raised its total revenues 72% in the second quarter from the year-earlier period to nearly $1.8 million. For the first half of 1985, the company recorded revenues of $3.3 million, up 96% over the equivalent period last year. Of the second-quarter revenues, almost $1.4 million came from product sales, a gain of 89% on an annual basis. Still, the company continues to report losses—$601,000 in the second quarter, for example. Finances were improved, however, through private stock placements in May and July that netted the company a total of $1.4 million.

The really positive news for Monoclonal Antibodies in recent months, however, was the late August ruling by a judge of the federal district court in San Francisco, invalidating a Hybritech patent on a certain monoclonal antibody technology related to diagnostics (C&EN, Sept. 9, page 6). Hybritech had sued the smaller firm in March 1984, claiming patent infringement. The victory for Monoclonal Antibodies, which Hybritech may appeal, means the likely end to a severe drain on the company's finances. Direct legal costs in the second quarter alone totaled $372,000. The company also hopes that, with the possibility of constraints on the company's products apparently gone, its standing with investors and customers will improve.

The biggest biotechnology-based company remains Genentech, which boosted second-quarter revenues 24% from a year earlier to $21.4 million and net income 76% to $1.1 million. Over the first six months of 1985, the company's revenues, 91% of which are derived from contract fees, rose 28% to $41.6 million, and earnings jumped 80% to $1.8 million. Genentech, which continues to increase its R&D spending aggressively, is still marketing no proprietary products.

During the second quarter, Genentech broadened its collaboration with Boehringer Ingelheim, which bought just under 5% of the South San Francisco, Calif., company's common stock for $40 million in a first-quarter private placement. The two firms announced a plan to establish a cancer research center in Vienna, and a joint venture called Genentech Canada was formed between Genentech and Boehringer Ingelheim (Canada) to market human pharmaceuticals developed by Genentech. In July, Genentech licensed some of its animal health care products to Ciba-Geigy for worldwide manufacture and marketing. The deal will bring Genentech $42 million in cash plus royalties on product sales.

"This agreement will enable us to get our animal health products more quickly to market without diverting our focus from human health care," says Robert A. Swanson, Genentech's chief executive officer.

Among other firms with solid second-quarter increases in revenues, Amgen reported a 77% jump to $3.3 million, while turning in a loss of $2.0 million, slightly less than in the same period a year before. Amgen's expenses rose 36% from the year-earlier period to nearly $5.4 million in the second quarter. The increase was caused primarily by added investments in process scale-up and regulatory approval work, the company explains.

Currently, Amgen is moving into a second round of field studies of its consensus interferon for the prevention of cattle shipping fever, and is carrying out human clinical trials of gamma interferon as a therapeutic agent for a range of cancers. The company also reports greatly increased sales of its line of recombinant peptides, including erythropoietin, interleukin-2, consensus and gamma interferons, insulinlike growth factor, and epidermal growth factor to biomedical researchers. In late July, Amgen formed a partnership with Arbor Acres, a private supplier of chicken breeding stock in Glastonbury, Conn., to apply genetic technology to the breeding of chickens and turkeys.

At Bio-Response, total revenues more than tripled from second-quarter 1984 to $1.1 million, fueled by a 978% jump in contract revenue to just over $1 million. BioTechnica International reported a 229% increase in total revenues to nearly $1.3 million, thanks chiefly to new research contracts. And DNA Plant Technology revenues rose 30% to just over $1 million in the second quarter as the company signed on new research clients for a variety of projects.

Negative performance reports continued to be dominated by Genex, whose second-quarter revenues plummeted 41% from last year's second quarter to $4.8 million and net loss swelled to $2.3 million from $2.0 million in the equivalent year-earlier period. The stricken company, whose all-important supply contract with G. D. Searle will expire and not be renewed next month, has lost $4.7 million over the first six months of the year, far more than the $3.6 million lost by mid-1984. Genex's stock price reached all-time lows in recent weeks and Genex now is trying to convert its Paducah, Ky., plant, which has been manufacturing L-phenylalanine for Searle under the soon-to-be-defunct contract, to a contract manufacturing facility.

At Molecular Genetics, revenues slumped 14% in the second quarter and were down 12% in the first half of 1985. Over the six-month period, sales of the Minnetonka, Minn., firm's two animal health care products—a test kit to detect *Escherichia coli* scours in calves and a monoclonal antibody treatment for the affliction—were little more than level. "There continues to be a shortfall in product revenues against our beginning of the year expectations," concedes Franklin Pass, the company's chief executive officer. In response, the firm reduced research, sales, and administrative expenses 15% from the budget plan during the first half and is taking steps to improve its marketing effort, Pass says. □

Bleak future predicted for petrochemicals

Forecasters of growth in U.S. demand for and production of petrochemicals see only a downward trend. Estimates of returns on investment, future capacity, and trade balances for petrochemicals also are heading downward. These views continue to be held by investors who for more than a decade have put relatively low values on the stocks of most major chemical companies.

A bleak outlook—but not without some bright spots—for petrochemicals in particular and for the chemical industry in general was painted by speakers at conferences on feedstocks and strategic planning for petrochemicals sponsored by the Energy Bureau in Houston earlier this month. Increased flexibility in use of feedstocks to make chemicals, a slow increase in the profitability of chemicals manufacturing, and a conclusion that the threat of new foreign competition has been overestimated were some of the positive assessments.

Over the next 10 years, smoothed curves for growth in U.S. ethylene demand will show annual rates of 1 to 2%, according to Joseph H. Posevina, manager of chemical services for Data Resources Inc. in Houston. Posevina estimates that consumption of the various derivatives of ethylene will reach 35 billion lb in 1994, up from just over 31 billion lb in 1984. Polymers, made from ethylene or intermediates based on ethylene, will account for most of the growth in demand. Growth in demand for polymers actually will offset losses in demand for a half-dozen ethylene derivatives such as ethanol, acetic acid, and the chlorinated ethylenes.

The trade balance in ethylene—almost all in derivatives—will continue to decline steeply. But after about 1990, both the decrease in exports and the rise in imports will slow, moderating the decline in net trade. However, net trade will fall from a peak of about 4.8 billion lb of ethylene equivalents in 1983 to about 1 billion lb by 1995.

Posevina predicts that as a result of shifts in demand and in the net trade balance in ethylene derivatives, growth in production will be small and overcapacity will continue. Profit margins will remain weak as prices hold at levels well below those desirable for reinvestment.

The outlook for another important olefin made in steam crackers, propylene, is brighter than that for ethylene, according to Stephen N. Rothman, a vice president of Chem Systems. Not only will domestic demand for propylene grow faster than will demand for ethylene, but net trade in propylene derivatives will keep rising slowly and reach an annual level of more than 2.2 billion lb in the early 1990s. The amount of propylene required for alkylation, however, will continue to be the major factor determining propylene prices as changes in supply-demand relationships between propylene made in refineries and that made in steam crackers remain secondary in importance.

Butadiene's outlook depends almost entirely on U.S. automotive industry trends, Rothman says. Its supply will be determined by the kind of hydrocarbons fed to steam crackers, with the supply limited as long as the very light hydrocarbons get preference. In the long term, imports are expected to decline. Other C_4 hydrocarbons will be dehydrogenated to make butadiene as supply and prices dictate.

Refineries will remain the main supplier of major aromatics for chemical use, says Merritt G. ("Red") Marbach, who is a business research manager for base chemicals at Shell Chemical. More than 70% of aromatics—benzene, toluene, and mixed xylenes—used in making chemicals come from catalytic reforming in refineries, with about 25% coming from pyrolysis gasoline produced in steam crackers, and the rest coming from coking coal.

Costs of aromatics, which chemical users will have to pay, likely will be higher, reflecting the increased costs to refiners of replacing lead alkyls—which are being phased out of gasoline by the federal government—with other sources of octane value. Already the marginal costs of increasing the octane value of gasoline have risen from about 0.6 cent per octane number per gal in 1984 to 0.8 to 1.0 cent today. As the lead phasedown is completed, additional increases to 1.0 to 1.2 cents may occur. These marginal octane costs reflect the assumption that the mixture of gasolines offered, generally a regular and a premium, will have an average octane value of 88.8 to 89.0. The change in marginal octane costs from 0.6 cent per octane-gal to 1.0 cent increases the value of the toluene and mixed xylenes in the refinery gasoline pool 7 to 8 cents per gal. Should marginal costs rise to as much as 2 cents per octane-gal, the increase in value of these aromatics would be 26 to 27 cents per gal.

The changes made during the early 1980s in steam crackers to allow use of all kinds of hydrocarbons are helping the petrochemical industry's competitiveness, says Richard L. Baldwin, vice president and general manager of Union Carbide's hydrocarbons department. By having the flexibility to shift between ethane-propane mixtures and naphtha and gas oil, olefin-producing plants will remain more efficient than units without such flexibility. About 80% of the U.S. ethylene industry has light feedstock flexibility, and about 55% of the industry can handle naphtha and gas oil. The inflexible steam crackers, often uncompetitive now, are likely candidates for shutdown. □

U.S. demand for ethylene will grow slowly for another decade

Product	Ethylene consumption (billions of lb)				
	1974	1979	1984	1989	1994
Linear low-density polyethylene	0.0	0.2	2.4	3.8	4.9
Low-density polyethylene	6.3	7.9	6.2	5.1	4.4
High-density polyethylene	3.0	5.3	6.3	7.3	8.3
Ethylene oxide	4.4	5.4	5.2	5.3	5.5
Ethylene dichloride	3.3	4.4	4.3	4.7	5.0
Ethanol	1.0	0.9	0.7	0.3	0.0
Vinyl acetate	0.4	0.7	0.7	0.8	0.9
All other	2.6	3.0	2.9	3.2	3.4
TOTAL	22.9	30.0	31.0	33.0	35.0

Source: Data Resources